The title of the present specification has been amended to be consistent with the claimed invention, and Figures 1, 2A, and 2B have been amended to include a legend "Prior Art" as required by the Office Action. Applicants believe that objections to the specification have now been overcome.

In response to the indefiniteness rejection under 35 U.S.C. §112, second paragraph, Applicants have canceled Claims 5 and 10-11 without prejudice or disclaimer and amended Claims 3-4, 7, 9, and 12. Accordingly, amended Claims 3-4, 7, 9, and 12 are believed to be definite and no further rejection under 35 U.S.C. §112, second paragraph, is anticipated.

Applicants propose changes to Figures 1, 2A, and 2B as set forth in the letter requesting drawing corrections filed together with this response. Specifically, Figures 1, 2A, and 2B have been amended to include a legend "Prior Art" as indicated by the Office Action. Proposed changes to the drawings are highlighted in RED. Applicants respectfully submit that no new matter is added by this amendment. In view of the above, it is believed that objections to the drawings have been overcome.

In response to the rejection under 35 U.S.C. §102(e), Applicants have amended Claim 1 to more clearly define the features recited herein.

Amended Claim 1 recites a semiconductor device including a semiconductor substrate, and a circuit element using an insulating film formed on the semiconductor substrate. The insulating film contains a silicon compound containing at least one element selected from the group consisting of an oxygen and a nitrogen, and a metal compound containing a metal other than silicon and at least one element selected from the group consisting of an oxygen and a nitrogen, the insulating film further including nano-crystals, a particle diameter of the nano-crystals being within a range of between 1 nm and 10 nm. The insulating film of the claimed invention is not amorphous. See page 11, lines 4-8, of the present specification.

In order to obtain nano-crystals having a diameter within a range of between 1 nm and 10 nm, the insulating film must essentially be of an oxide. As described in the Examples provided in the present specification, the insulating film is made of an oxide. The insulating film may contain a small amount of nitrogen. However, if an excessive amount of nitrogen such as to generate nitride or oxynitride is included in the insulating film, the crystallization is disturbed, and as a result, the insulating film becomes amorphous. To prove this point, Applicants submit herewith an article entitled "Application of HfSiON as a gate dielectric material" (Applied Physics Letters, vol. 80, No. 17, April 29, 2002).

Thus, as noted above, if the insulating film contains an excessive amount of nitrogen, it would not be possible to obtain nano-crystals having a diameter within a range of 1 nm and 10 nm. Excessive nitrogen also contributes to the precipitation of the nano-crystals in the insulating film.

However, the present invention makes it possible to suppress the leakage current derived from the grain boundary and to suppress the non-uniformity in the threshold value and the driving force, thus making it possible to improve the characteristics of a MOS transistor, etc. See, as a non-limiting example, page 16, line 26, to page 17, line 6, of the present specification.

For the foregoing reasons, the gate insulating film of the present invention can be used as a gate insulating film of a MOSFET as recited in new Claims 16-26. The prior art of record fails to teach or suggest such an insulating film.

Wallace relates to a field effect semiconductor device including a high permittivity zirconium (or hafnium) silicon-oxynitride gate dielectric and a method of forming the same. Wallace at col. 8, lines 4-14, describe the formation of a metal silicon-oxynitride layer 36 by oxynitridation.

As noted above, nano-crystals having a diameter within a range of between 1 nm and 10 nm cannot be made in an oxynitride layer. Thus, one skilled in the art would conclude that nano-crystals having a diameter within a range of between 1 nm and 10 nm are not present in Wallace's metal silicon-oxynitride layer 36. Applicants, therefore, believe that Wallace teaches away from the claimed invention. Since Wallace fails to teach or suggest all the requirements of amended Claim 1, it is respectfully submitted that Claim 1 and its dependent claims are patentably distinct over Wallace.

Hseih merely discloses that a high dielectric constant and low leakage dielectric material in which the thickness of the metal-silicon alloy is within the range of 5 to 50 nm. Hseih, however, fails to teach or suggest nano-crystals having a diameter within a range of between 1 nm to 10 nm as recited in the claims. Thus, Hseih fails to cure the deficiencies of Wallace. Thus, even if Wallace were to be combined with Hseih, the requirements of amended Claim 1 are not still met. In view of the above, Applicants believe that Claim 1 is patentably distinct over the prior art of record.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested. While it is believed that the instant amendment places the application in condition for allowance, should the Examiner have any further comments or suggestions, it is requested that the Examiner contact the undersigned at 703-413-3000.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

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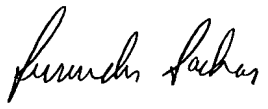

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Marked-Up Copy
Serial No: 09/891,129
Amendment Filed on:
10/31/02

IN THE SPECIFICATION

Please amend the specification as below.

IN THE TITLE

Amend page 1, lines 2-3 to read as follows:

SEMICONDUCTOR DEVICE HAVING AN INSULATING FILM MADE OF A HIGHLY DIELECTRIC THIN FILM AND METHOD OF MANUFACTURING THE SAME

IN THE CLAIMS

Please cancel Claims 5, 10, and 11 without prejudice or disclaimer and amend Claims 1, 3, 4, 7, 9, and 12 as follows:

1. (Amended) A semiconductor device comprising:

a semiconductor substrate, and

a circuit element using an insulating film formed on said semiconductor substrate,

said insulating film containing a silicon compound containing at least one element selected from the group consisting of an oxygen and a nitrogen, and a metal compound containing a metal other than silicon and at least one element selected from the group consisting of an oxygen and a nitrogen, [nano-crystals being formed in] said insulating film further comprising nano-crystals, [the size of said nano-crystal being small enough to permit

observation of a polycrystalline ring as a diffraction image when an electron beam having a beam diameter of the nanometer order is incident in parallel to said insulating film surface] a particle diameter of said nano-crystals being within a range of between 1 nm and 10 nm.

3. (Amended) The semiconductor device according to claim 1, wherein said nano-[crystal] crystals [grains] are made of said metal compound.

4. (Amended) The semiconductor device according to claim 2, wherein said nano-[crystal] crystals [grains] are made of an oxide, a nitride or an oxynitride of a metal other than silicon.

5. (Cancelled).

7. (Amended) The semiconductor device according to claim 1, [wherein an oxynitride film is formed] further comprising a silicon oxynitride film between said semiconductor substrate and said insulating film

9. (Amended) The semiconductor device according to claim 1, wherein said [functional] circuit element is a MOSFET, and said insulating film is a gate insulating film of said MOSFET.

10-11. (Cancelled).

12. (Amended) The semiconductor device according to claim 1, wherein a part of [the] a periphery of at least one of said nano-crystals being positioned within a distance of 0.7 nm from the interface of said insulating film.

16-26. (New).--